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Taming wicked civic challenges with an innovative crowd

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Abstract Civic challenges such as urban mobility and energy problems offer new corporate innovation opportunities. However, such challenges are wicked and difficult to tame. They require novel solutions that account for and integrate contradictory perspectives within the local innovation ecosystem of firms, governments, and citizens. This article presents a successful civic innovation crowdsourcing project case study, in which multinational firm Bombardier encouraged a global civic crowd to co-create visionary solutions to the challenge of future mobility in crowded cities around the world. Bombardier recruited a global crowd of 900 individuals and facilitated the citizen development of more than 215 solutions of unique firm value. We explore the process and outcome of this crowdsourcing project and derive actionable design principles for a three-phased civic innovation crowdsourcing process including: (1) crowd construction, (2) crowd knowledge acquisition, and (3) crowd knowledge assimilation. This process enables the crowd to integrate members' diverse and contradictory knowledge proactively at both the team and individual levels. Additionally, the crowd is able to balance extension of existing local solutions and exploration of path-breaking technologies and solution concepts.
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1. Setting the scene: Corporate innovation opportunities in civic innovation

Today, many firms seek to establish themselves as leaders in civic innovation by developing novel solutions for concerns such as mobility, energy, and food safety (Frost & Sullivan, 2014). To establish leadership in innovation, firms pioneer the exploration of new civic opportunities (Cisco, 2014; IBM,

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2014; Maerivoet et al., 2012), hoping to gain a competitive edge as based on their unique insights regarding how to address particular civic challenges (Williamson & De Meyer, 2012).

Developing such an innovative advantage is, however, not easy. Civic challenges represent so-called 'wicked' problems that are influenced by factors in multiple and often contradictory ways (Rittel & Webber, 1973; Simon, 1962). Wicked problems are unsolvable in the sense that they do not have objectively optimal solutions; any solution values will be deeply embedded in the problem's local social context (Camillus, 2008; Conklin, 2005). Despite the attention given to wicked problems by public policy and urban planning experts, a lack of insight exists regarding how corporations can develop innovation opportunities for wicked civic challenges—processes that would require firms to align their own corporate agendas with the broader interests of their local innovation ecosystems. These local networks of firms, governments, and citizens play an important role in developing and delivering new solutions for civic challenges (Williamson & De Meyer, 2012).

In this article, we focus on firm-sponsored civic innovation crowdsourcing as a process that is advantageous to firms. Using the public, firms may develop unique knowledge groups to generate novel solutions to wicked civic problems (Almirall, Lee, & Majchrzak, 2014; Prpić, Shukla, Kietzmann, & McCarthy, 2015). Herein, we investigate the YouCity Challenge sponsored by Bombardier, a large mobility infrastructure provider. Under this initiative, Bombardier recruited a public crowd of about 900 individuals from around the globe via an open call and asked them to develop new urban mobility solutions for cities of the future. Harnessing the knowledge of this crowd, Bombardier acquired hundreds of unique insights and conceptual solutions. This pool of know-how represented a valuable extra-organizational asset that Bombardier could access and use to develop visionary solutions capable of establishing the firm as a leader in civic innovation in the area of urban mobility. Indeed, according to Martin Ertl, chief innovation officer of Bombardier (2014), the crowdsourcing initiative spurred Bombardier's strategic goal of "moving away from simply responding to customer inquiries and tenders. . . . to writ[ing] a new chapter in public transportation."

This article sheds light on how firms should construct and manage civic crowds in order to tame wicked civic challenges and balance the contradictory perspectives of different innovation ecosystem actors. We present a set of process design principles that allow managers to sense and seize innovation opportunities valuable to their firm.

2. Mastering wicked problems: Lessons learned from public planning

Wicked problems are discussed regularly in the context of public policy and urban planning (Farley, 2007); however, we focus on wickedness from the perspective of a corporate firm rather than that of a policy maker or urban planner. In taking such a corporate view, we should reiterate that wickedness does not refer to a problem's degree of difficulty. As pointed out by the originators of the wickedness concept, wickedness points to the set of distinct, elusive features of a problem that constitute its wickedness (Rittel & Webber, 1973).

Experts in public policy and planning have deliberated on how best to address these allegedly unsolvable problems (Rittel, 1972; Rittel & Webber, 1973). A general lesson learned is that the problem-solving mode focuses on taming rather than solving wickedness, as there is no objectively optimal solution to a wicked problem (Conklin, 2005). Specifically, prior work informs us that the problem-solving process used to tame wicked problems should support the development of solutions that are integrative and contextualized.

Developing integrative solutions is necessary because "the expertise [that] you need in dealing with a wicked problem is usually distributed over many people" (Rittel, 1972, p. 394). Thus, both experts and non-experts should be involved in the problem-solving process as they both hold critical, practical knowledge of the problem at hand. Wicked problem solving should actively involve the stakeholders affected by the problem; as stated by Rittel (1972, p. 354), "nobody wants to be 'planned at.'" To develop a rich understanding of the controversial perspectives of different stakeholders, it is particularly important to stimulate a dialogue-based process via which participants can raise issues and share their subjective perspectives, which are often contradictory to one another (Conklin, 2005; Innes & Booher, 2010; Kunz & Rittel, 1970).

Additionally, the wicked problem-solving process should support the development of contextualized solutions that consider local circumstances (Conklin, 2005; Innes & Booher, 2010). Civic challenges are deeply embedded in the local context and thus require customized solutions. Even though some wicked problems seem to be structurally similar to each other, there remain distinct differences across various settings. For example, the technical conditions for constructing a subway in London may appear similar to the conditions of building one in New York. However, despite similarities in subway layout, building types, and other factors, differences in commuting patterns and mobility needs

may require very different and fitted solutions (Conklin, 2005). This context dependency calls for processes sensitive to local settings.

Wicked problem experts have shown that a focus on knowledge integration and contextualization can help a group of stakeholders tame wicked problems (Conklin, 2005). However, most of the existing advice and tools are drawn from small, team-based projects facilitated by rather neutral actors, such as governments or urban planners with no profit-oriented goals. But how should corporate firms work with a large crowd of strangers in order to realize integration and contextualization? To answer this question, we introduce the concept of civic innovation crowdsourcing.

3. Civic innovation crowdsourcing: A new way to tame wicked problems?

Crowdsourcing describes an online, distributed problem-solving model under which organizations employ IT to outsource an organizational function to a strategically defined population of human and non-human actors in the form of an open call (Kietzmann, 2017). In this article, we focus on firm-sponsored innovation crowdsourcing efforts wherein firms aim to create corporate innovation opportunities. Civic innovation is a new domain to which such firm-sponsored crowdsourcing can be applied. Firm-sponsored civic innovation crowdsourcing entails the firm focusing on a public crowd composed of human actors directly or indirectly affected by a particular civic challenge, to the end of harnessing knowledge about this civic challenge. Digital technologies play a central role as they not only lower participation costs but also create a variety of alternatives for designing the crowdsourcing process and supporting social interactions among strangers (Majchrzak & Malhotra, 2013).

At first glance, civic innovation crowdsourcing appears to be a suitable mode for taming wicked civic challenges, as it responds to Rittel's (1972) call for direct involvement of diverse actors and the consideration of their subjective perspectives. However, we argue that whether a firm can tame a wicked civic challenge successfully depends on how the two conditions, integration and contextualization, are met. These conditions need to be considered across three major crowdsourcing activities (Prpić et al., 2015; Zahra & George, 2002):

1. Constructing the crowd by defining its nature and either selecting existing crowds or recruiting new crowds;
2. Acquiring knowledge from a crowd by designing the solution development process; and
3. Assimilating the knowledge from the crowd by integrating the crowd-based knowledge into organizational capabilities.

Our analysis of Bombardier's YouCity Challenge serves as a representative case study of a firm-sponsored civic innovation crowdsourcing project. It provides further insight into how design of the crowdsourcing process can meet the two conditions of successful wicked problem solving: knowledge integration and contextualization (Yin, 2003).

4. The Bombardier YouCity Challenge

As part of its YouCity Challenge, multinational firm Bombardier used a public crowd to create an extra-organizational knowledge pool that provided the firm with new civic innovation opportunities. Bombardier's ultimate goal was to establish itself as a global leader in urban mobility. The YouCity initiative, which took place in 2012 and lasted for 3.5 months, called for visionary submissions to shape the future of urban mobility in cities around the world. Structured as a type of contest, YouCity offered prizes for the three best solutions. The crowdsourcing project attracted participants from 74 countries to the online platform and garnered 215 idea submissions that included not only written descriptions but also video and graphical supplements (e.g., design sketches, solution visualizations). Core innovators actively took part in answering the call, and individuals on the periphery participated by simply observing the process. Upon the initiative's conclusion, the YouCity Challenge website tallied 132,000 visitors in total and 1,391 evaluations. Furthermore, the integration of Facebook resulted in 1,700 'likes.'

In performing our analysis of the YouCity Challenge, we retrieved archival data from multiple data sources. We accessed the database that stored the content of the platform, including text and attachments bearing solution submissions as well as file logs of participant interactions (e.g., voting on solutions, comments on solutions). We also accessed and analyzed project reports of the team managing the crowdsourcing effort.

We studied the data from two perspectives. First, we took a process perspective and explored the particularities of each of the three crowdsourcing stages following Prpić et al. (2015). Then, we focused on the outcomes—the actual solutions created

by the crowd—in order to examine whether the crowd developed, integrated, and contextualized solutions. We coded the text of 90 original solutions submitted via online forms, along with approximately 100 pages of text documents submitted as attachments (e.g., PDFs, Word files). Following established coding procedures, we applied a descriptive coding using nominal ratings (Saldana, 2012). Two individuals separately coded the ideas. The inter-rater agreement coefficient of 91.98% for the two raters was very satisfying (Gwet, 2014). Finally, we performed a descriptive statistical analysis based on the extracted codes.

5. The process: How Bombardier worked the crowd

In developing its YouCity Challenge, the Bombardier innovation team purposefully designed the phases of crowdsourcing:

1. Constructing the crowd;

2. Acquiring knowledge; and

3. Assimilating knowledge from the crowd.

Next, we will discuss each phase individually with a focus on how the process supported integration and contextualization, which are both essential for wicked problem solving.

5.1. Phase 1: Constructing a truly diverse crowd

To conquer its wicked challenge, Bombardier realized that the YouCity crowd needed to be much more heterogeneous than the single-focus crowds accessible via platforms like Topcoder.com and Innocentive.com, which bring together technology experts in software and science, respectively (Jeppesen & Lakhani, 2010). Thus, the YouCity crowd construction phase focused on recruiting a truly diverse public crowd of urban planners, engineers, scientists, entrepreneurs, and non-experts with practical experience in using local transportation in cities around the world. Next, we describe two components of how Bombardier constructed the diverse crowd.

5.1.1. Specifying diversity in terms of three dimensions

Bombardier defined its crowd along three dimensions of diversity: geographic context, skills, and type of innovation ecosystem actor. To ensure diversity in terms of geographic context, Bombardier deliberately focused on participants from three cities on three different continents (Bohler-Baedeker, Kost, & Merforth, 2014; Johnson & Gann, 2010; Kitchin, 2014):

1. London, United Kingdon—A city in a mature market;

2. Belo Horizonte, Brazil—A member of the five newly industrialized countries (Brazil, Russia, India, China, and South Africa); and

3. Vientiane, Laos—A city in an emerging market.

To ensure diversity related to disciplinary knowledge and skills, the YouCity call for submissions emphasized the crucial role of interdisciplinary submissions from people with different skills and experiences. Besides individuals with practical experience in day-to-day transportation usage, Bombardier aimed to attract expert volunteers with skills in the areas of urban planning and policy, civic engineering, and management.

Finally, Bombardier wanted to ensure diversity of ecosystem actors in the crowd. It required representation of the key innovation ecosystem actors needed to develop and use the new mobility product or service. This included developers and engineers (who take care of the technological development), urban planners (who envisage the strategy of an urban area), creative urban entrepreneurs, and mobility service end-users.

5.1.2. Using a mixed recruiting strategy to realize three-dimensional diversity

To assemble the desired crowd, Bombardier's recruiting strategy combined two approaches. One approach entailed the targeted recruitment of participants from existing social media sites. Here, the innovation team identified relevant sites—such as blogs, online forums, and social networks—and then observed the users of these sites and the nature of their discussions; this was achieved through active participation following principles of ethnographic research (Kozinets, 2002). Platform administrators were then asked for permission to advertise the YouCity challenge on these sites.

The second approach employed word of mouth. The team encouraged registered crowd members to share the YouCity invitation within their individual networks. The team also directly contacted influential individuals with a high degree of influence. Very connected users with high visibility (e.g., large number of followers) on relevant sites were informed about the civic innovation crowdsourcing

initiative in order to spread the word. The recruiting efforts were monitored continuously to measure source-specific growth from different channels, number of links on other websites to the challenge website, and diversity of registered individuals.

5.2. Phase 2: Acquiring co-created solutions from the crowd

Following the crowd construction phase, Bombardier set out to acquire knowledge from the crowd. The firm took measures to ensure that the crowd integrated the diverse knowledge and perspectives of the innovation ecosystem and contextualized their proposed solutions. Five design principles, outlined next, were particularly critical to knowledge acquisition.

5.2.1. Establishing multiple stages in the crowdsourcing process

To support the crowd in developing integrated solutions, the YouCity crowdsourcing process was broken down into two stages. In the first stage, registered participants were asked to submit original ideas that considered multiple dimensions of the challenge. The contest guidelines suggested that participants analyze local challenges, obstacles, and micro-trends before submitting original integrative solutions. In the second stage, participants were asked to extend previously proposed solutions that had been posted to the online platform. These stages were not rigidly separated in terms of time; participants could also submit original submissions at a later stage.

5.2.2. Facilitating a transparent dialogue

Each stage of the YouCity project emphasized communication among the participants. Instructions on the platform specifically asked participants to engage in transparent dialogue throughout the overall period of the online crowdsourcing contest. Individuals were explicitly encouraged to share their problem views and support them with personal experiences, as well as with facts and figures related to local urban mobility challenges. Design of the platform also supported this transparent dialogue. All participants had access to submissions and comments, which reflected subjective points of view. Transparent communication supported Rittel's (1972, p. 394) quest for objectification, which describes the process of "making the basis of one's judgment explicit and communicating it to others." In other words, transparency instructions and design features allowed and even helped participants to express their subjective opinions, articulate the rationale behind their points of view, and share local insights about a particular problem and solution.

5.2.3. Fostering knowledge co-creation among individual crowd members

To realize knowledge integration, the acquisition phase not only encouraged the crowd to engage in transparent dialogue but also co-create new knowledge actively. *Co-creation* describes a process in which individuals build upon each other's knowledge contributions through three actions: knowledge sharing, highlighting, and combining knowledge (Majchrzak & Malhotra, 2013).

Guidelines and instructions provided to the crowd explicitly encouraged members to share their knowledge openly. Sharing different views toward issues was pivotal in informing others about the local context of a problem. For example, in the conversation, participants exchanged information about local traffic/road conditions to underscore the need for a solution that supports safety. Consider the following traffic report regarding Laos, published by the U.S. Department of State (2012):

> 2011 recorded a significant increase in vehicle congestion over previous years. Visitors should be extremely alert to traffic patterns and unexpected movements by motorcycle drivers. Traffic laws and driving habits throughout Laos fail to achieve Western standards. Death and injury attributed to motorcycle and passenger vehicle accidents are commonplace throughout Laos. The seriousness of this is exacerbated by the unavailability of quality health care.

Other participants provided information and explanations of technologies to describe technical challenges and possible remedies. The shared insights were not necessarily new, but they helped the community to integrate the problem and solution knowledge and develop solutions sensitive to a particular local context.

Shared insights and comments were both encouraging and conflicting at times. This dissonance made salient the inherent contradictions of wicked problems. One member's comment illustrates a disagreement among participants regarding estimated efforts and costs of a specific technological development:

> Thanks for the comment. . . . I do agree that hardware cost will be a little high. But software I don't think will be that complex. . . . I have already [singlehandedly] created a simulation of such a city on a small scale as a swing program. . . . Building it as a team will require [a] lot less time and effort. Building a system for

> underground will be less complex. I'll upload the video of my simulation application very soon for reference. (Participant, YouCity Contest)

We learned that disputes and controversial discussions align perspectives, clarify what is critical, and help refine rough conceptual solutions.

In addition to knowledge sharing, the process also supported the crowd in highlighting pieces of information. Features like evaluations and tagging allowed participants to channel attention toward relevant and promising solutions. To motivate individual engagement in the important activity of highlighting, Bombardier established an award for the most active community member. In total, participants provided more than 1,390 evaluations. Such evaluations helped to select and further refine solutions.

Finally, all participants were instructed to engage in knowledge combination as an explicit task. Members were asked and encouraged to integrate solutions, combine different thoughts and solutions, and reference others' work in their submissions. The following comment illustrates the crowd's intent to combine knowledge:

> Fundamentally, the ideas we have put forth are very similar and rely on a lot of the same base concepts. It would be great if we could figure out a middle ground to merge the best parts of the two, though I understand that may not be possible. (Participant, YouCity Contest)

Overall, participants actively combined knowledge and referenced others' submissions. Indeed, more than 30% of the entries referenced other solutions—and in some cases, several different contributors' ideas.

5.2.4. Triggering knowledge integration through team submissions

In addition to crowd-level measures such as instructions and support for participants to share their views, the YouCity platform encouraged team submissions in order to foster knowledge integration. A distinct phase at the beginning of the initiative was dedicated to the formation of teams. In this phase, community managers encouraged participants with complementary backgrounds to join forces and form teams. In total, 26 teams emerged, consisting of 3.6 team members on average. The two levels of knowledge integration, both within and across teams, complemented each other.

5.2.5. Using problem contextualization to trigger awareness toward local conditions

The acquisition phase also enabled the crowd to pay attention to local boundary conditions. As mentioned earlier, the call for submissions was two-fold: proposed solutions could relate to urban mobility as a global problem, or they could be tailored to the local conditions of three cities—London, Belo Horizonte, or Vientiane. The call for submissions provided hints about the specifics of the cities in order to make participants aware of the local context. The crowdsourcing platform gave individuals the option to select one of the three cities and submit a city-specific solution. At the same time, individuals could also select multiple cities or submit their idea as a global solution without any city reference. In other words, the processes supported the crowd to either contextualize or abstract their problem-solving approach. The crowd opted for both types of submissions. In the first round of 90 original submissions, 36 were submitted for London, 25 for Belo Horizonte, and 14 for Vientiane, respectively. Fifteen proposals were submitted as global solutions.

5.3. Phase 3: Assimilating knowledge from the crowd

The assimilation phase was essential to further contextualize and integrate the crowd's knowledge with Bombardier's strategic interests and technological capabilities. Next, we discuss what we learned about two process design principles that facilitated this phase.

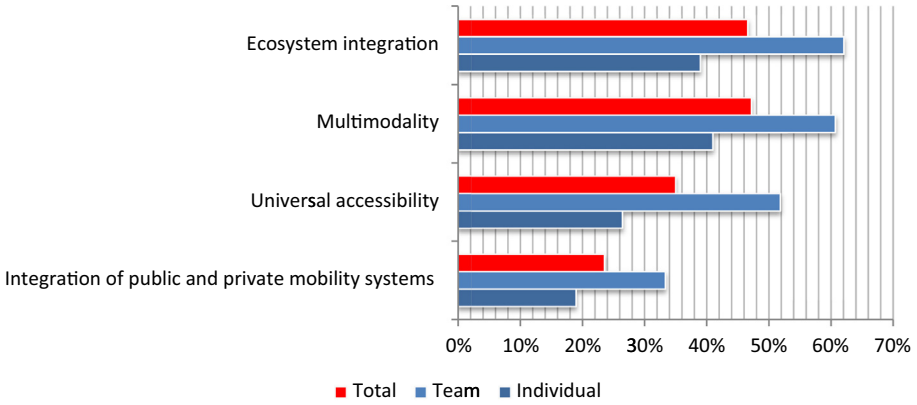
5.3.1. Providing transparency about the corporate agenda

Bombardier took measures to ease the assimilation of external knowledge by maintaining transparency about the firm's corporate agenda and internal technologies. For example, feature films about Bombardier's in-house technologies and products were disseminated among the participants; other corporate information was shared, too. Once the online contest was completed, Bombardier held a face-to-face innovation camp at its global transportation headquarters in Berlin. During this camp, Bombardier revealed further insights about its own internal technologies in development.

5.3.2. Supporting co-creation between employees and crowd members

Following the conclusion of the YouCity Challenge, Bombardier fostered co-creation among the creators of the best solutions, various Bombardier employees from innovation, marketing, and R&D, and external industrial designers. A four-day workshop facilitated alignment of the best solution concepts with the firm's internal corporate agenda and the

Figure 1. Integrative solutions and team boundaries



development of a roadmap for further detailing and implementation of these mobility concepts.

6. The outcome: Integrative and contextualized solutions

So far, we have provided insight into how Bombardier designed the process to create integrative and contextualized solutions. Next, we explore the outcomes of this process. We take a closer look—both in terms of integration and contextualization—at characteristics of the conceptual solutions submitted by the crowd.

6.1. The crowd's perspective toward integrated solutions

The YouCity process encouraged the development of integrative solutions. Thus, we asked: How do such integration activities materialize in the actual solutions developed by the YouCity crowd? Do they really lead to solutions that focus on aspects of integration within the local urban mobility context (e.g., universal access, multimodality) that help to align the perspectives of different ecosystem actors affected by the wicked problem of mobility (Lerner, 2011)? To answer these questions, we analyzed the 90 original proposals submitted with respect to four integration attributes:

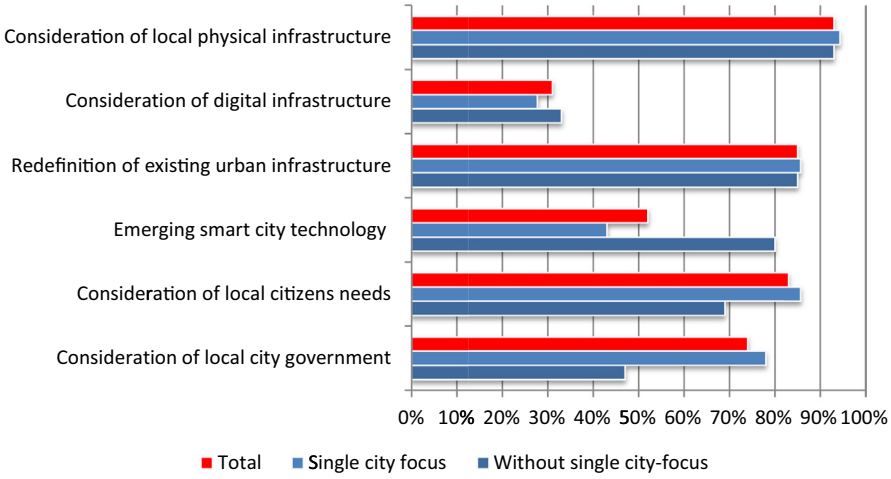
1. Ecosystem actor integration;
2. Multimodality (i.e., the integration of different mobility modes such as train, car, bike, or metro);
3. Universal access (i.e., access for multiple demographic groups); and
4. Integration of private and public mobility systems.

Our explorative content analysis illustrated that the crowd did propose integrated solutions. As shown in Figure 1, about 50% of the solutions proposed the integration of different actors and organizations in the mobility ecosystem, ranging from infrastructure providers to multiple mobility service providers and end users. Multimodality was also addressed by approximately 50% of the proposed solutions. Interestingly, only 35% of the solutions considered universal access and the integration of various demographic groups. We learned that less than 33% of the ideas explicitly integrated private and public mobility systems. These findings pointed Bombardier's managers to the difficulties of realizing fully integrated solutions from a citizen's point of view.

To support development of integrative solutions in the problem-solving process, the YouCity challenge encouraged the formation of teams among strangers. Some participants chose this option. Indeed, 32% of the submissions in our sample were team-based solutions, developed by 26 teams. Team submissions may facilitate a deeper knowledge exchange due to more cohesive and reciprocal interactions within team boundaries (Kunz & Rittel, 1970; Tsoukas, 2009; Yuqing, Kraut, & Kiesler, 2007). At the same time, there is also the risk that teams may become too inwardly focused because of the boundaries created. To shed light on the role of team-based innovation in the development of integrative solutions, we also present the integrative nature of team-based solutions in Figure 1.[1] A comparison of team-based and individual submissions suggests that the former are more integrative with respect to multitude of ecosystem actors, modes of

[1] We performed a Chi-square Fisher exact test, and the difference between the groups seems to be significant for all attributes except integration of private and public mobility assets at the level $p<0.05$, or $p<0.1$ (difference for ecosystem is significant at $p<0.05$, multimodality is significant at $p<0.1$, universal access is significant at the level of $p<0.05$).

Figure 2. Contextualized solutions and single-city focus



mobility, accessibility for different mobility users and demographic groups, and integration of the public and private sectors. Thus, team-based submissions seemed to facilitate the development of more integrative solutions that holistically considered various stakeholders, service modes, and user needs.

Team-based submissions equally benefit from crowd-based co-creation mechanisms, such as sharing and highlighting. In YouCity, any registered user could comment on team-based submissions, vote to highlight the importance of a proposed solution, and suggest that team-based ideas be integrated with other ideas. We found that team submissions received a slightly larger number of crowd evaluations (10.4/team vs. 7.8/single).[2] This suggests that the crowd and the teams mutually inspire each other.

In summary, these analyses suggest that the Bombardier YouCity case did support the creation of solutions that integrate the perspectives of different actors. We learned that both team and individual efforts have their advantages and disadvantages. For example, while teams seemed to take a more holistic and integrative view, individuals paid more attention to the central role of Bombardier in the emerging urban ecosystem. This suggests that firms should design processes and features that support both team-based and individual knowledge co-creation. Interactions and integration at multiple levels foster the development of integrative solutions.

6.2. Contextualization: The crowd's deep engagement with the local context

Contextualization is another important condition of successful wicked problem solving. Thus, we asked: How does the YouCity crowd contextualize the solutions? To answer this question, we analyzed the 90 original ideas with respect to the nature of the contextualization of the solution. We focused on six dimensions of contextualization of the solution toward a particular local urban ecosystem:

1. Local physical infrastructure (i.e., were local roads, buildings, etc., considered?);
2. Local digital infrastructure (i.e., were local sensor networks, wireless infrastructure, etc., considered?);
3. Local citizen needs;
4. Redefinition of existing urban infrastructure (i.e., were functions of existing roads or buildings redefined?);
5. Emerging urban technology (i.e., were emerging smart technologies proposed that allow for local contextualization?); and
6. Local governance structures (i.e., were roles of city councils, etc., considered?).

As depicted in Figure 2, many ideas (approximately 93%) built upon the existing local physical infrastructure of a particular city. Consideration of the existing digital infrastructure played a less important role (31%) in the proposed solutions. We found that more than 80% of the submissions creatively redefined existing urban infrastructures in the context of new mobility solutions. They proposed a functional integration of existing and new infrastructures. For example, one rather futuristic submission proposed a three-layer structure (road,

[2] ANNOVA test was significant at 0.1 level.

underground, and rail) for the city of London, integrating different infrastructures into a unique system of urban mobility. This finding suggests that the crowd moved beyond a linear extension of existing solutions toward a creative transformation with the help of smart city solutions. Further, the crowd deeply engaged with the needs of both local citizens and the city government for novel mobility solutions. An overwhelming majority of the ideas (83%) considered particularities of the mobility of citizens living in a specific city. In total, 74% of the ideas focused on the role of the local city government, suggesting that supporting contextualization in the process triggers individuals to immerse themselves in the local, physical context as well as the social and even political contexts. Such a crowd orientation can help firms like Bombardier explore opportunities for smart mobility that, with the help of information technology, expand and transform existing mobility solutions.

Bombardier encouraged submissions that were focused on a specific city while also supporting greenfield ideas. Put differently, the firm used problem contextualization to widen or narrow the problem-solving process of the crowd. We explored the issue of how focus on one particular city context is reflected in the outcomes. Figure 2 presents the descriptive results both for single-city focused ideas and global submissions. We found that there was a significant difference with respect to two attributes: the consideration of local government structures and the integration of smart city technologies.[3] Further, we discovered that city-focused submissions more carefully addressed the role of city councils in designing urban mobility innovations than did global greenfield concepts; indeed, 92% of the ideas focused on a particular city called for a solution that integrated local policy makers in the solution concept. In contrast, submissions proposed as global solutions considered the governance context less frequently (43%). Apparently, creating a solution for a single city makes it easier to embrace local governance conditions. Finally, we found that global submissions were frequently focused (80%) on revolutionary city technologies such as automated driving, while local solutions were not. This points firms to the contradictory need for localization on one hand and corporate interest in global solutions on the other. In sum, our analyses show that both local contextualization and global abstraction can mutually complement each other and allow firms to access extensions of local solutions as well as globally emerging trends.

[3] We performed a Chi-square Fisher exact test, and the difference between the groups seems to be significant for all attributes except for integration of private and public mobility assets at the level $p<0.05$, or $p<0.1$ (difference for ecosystem is significant at $p<0.05$, multimodality is significant at $p<0.1$, universal access is significant at the level of $p<0.05$).

7. Discussion: Actionable design principles for taming civic challenges with the crowd

This article illustrates that innovation crowdsourcing can create unique corporate benefits via insights regarding visionary and locally customized solutions for civic challenges. As civic challenges are wicked in nature, they require the intentional design of a civic innovation crowdsourcing process. In essence, our article clarifies that managers must first purposefully construct their own diverse crowd that reflects the local innovation ecosystem context. Then, they need to take deliberate actions to support the crowd's sensitivity to the local context, without preventing visionary global solutions. They must also foster knowledge collaboration and co-creation within and across teams by way of careful crowdsourcing process design. To assimilate knowledge from the crowd, managers need to design the final stages of the crowdsourcing project such that the crowd's problem-solving processes gradually and interactively align with the firm's organizational know-how. Table 1 summarizes nine actionable design principles that provide more detailed guidance regarding how to purposefully design the civic innovation crowdsourcing process. Next, we briefly discuss how these principles activate knowledge integration and contextualization in a three-phase interactive and collaborative crowdsourcing process.

During phase 1, the crowd construction phase, it is important to build a crowd that is truly diverse (principle 1). Existing crowdsourcing guidelines often suggest that managers should tap into established crowds (e.g., Topcoder.com for software developers, Kaggle.com for data scientists) in order to reduce recruiting efforts, or rely on self-selection via an open call. However, for wicked civic challenges, we advise that managers diligently should recruit a truly diverse crowd that mirrors the ecosystem impacted by the wicked problem. Such diversity is needed to prevent fragmentation and to foster integration of contradictory perspectives. We recommend a two-component recruiting process (principle 2) that integrates targeted recruiting from different social media sites through word of mouth.

During phase 2, the acquisition process, design principles 3 through 7 help managers to centerstage dynamic interactions and crowd knowledge flows.

Table 1. Design principles for civic innovation crowdsourcing

Phase	Design Principles	Expected Impact	
		Integration	Contextualization
Phase 1: Crowd Construction	**1. Specify the properties of diversity of the crowd in a multidimensional way** Recruit a diverse crowd with respect to three dimensions of diversity: geographic context, skills, and ecosystem actors.	X	X
	2. Combine targeted recruiting and word of mouth Combine targeted recruiting efforts after ethnographic observation of different social media sites through word of mouth.		X
Phase 2: Knowledge Acquisition	**3. Realize a two-stage crowdsourcing process** Encourage the crowd to submit original solutions that consider the problem holistically, and encourage revised submissions at a later stage.	X	X
	4. Encourage transparent dialogue among the crowd Invite the crowd to reveal its point of view and comment on others' proposals, even if they are contradictory views; ask for facts, experiences, and stories.	X	X
	5. Support co-creation at the crowd level Enable the crowd to move beyond dialogue and combine solutions by giving instructions, using technology features (e.g., voting) and incentives (e.g., awards for integration).	X	
	6. Call for both team-based and individual submissions Encourage both team-based and individual submissions to foster within and across team knowledge integration.	X	
	7. Trigger sufficient contextualization Facilitate the crowd to engage more deeply with the local urban context but also allow wild, abstract submissions.		X
Phase 3: Knowledge Assimilation	**8. Increase employee participation over time** Shift from passive toward active firm participation over time to align external and internal knowledge gradually and facilitate co-creation with internal employees.	X	
	9. Provide transparency about corporate goals and know-how Share your corporate goals and problem-related internal know-how to align collective and corporate problem solving.		X

A multistage crowdsourcing process (principle 3) and transparent dialogue among the crowd (principle 4) need to be carefully designed in order to foster controversial discussions. Beyond dialogue, actual co-creation needs to happen at multiple levels; both individuals (principle 5) and teams (principle 6) should recombine and integrate their solutions. Instead of just focusing on crowd-level activities like voting, highlighting, and combining (Malhotra & Majchrzak, 2014), we advise managers to encourage team formation and inter-team collaboration explicitly. Such multilevel interactions are essential. Additionally, managers should enable crowds to address the local problem context (e.g., economic, social, and geographic factors) by providing specific information about local conditions in

the call for submissions (principle 7). Under YouCity, our urban mobility case study, the call for submissions encouraged the crowd to be sensitive to the local conditions of specific cities. At the same time, Bombardier also provided the option to submit global solutions. This approach balanced the dual need for both local solutions that extended existing infrastructures and more revolutionary, interconnected solutions that allowed Bombardier to provide vision beyond a single city and establish global leadership.

In phase 3, the assimilation phase, firms need to trigger the crowd to align their solutions with the corporate agenda. In addition, firms also need to begin reconfiguring internal capabilities. From a corporate point of view, it is important to foster this alignment in an interactive way and increase integration efforts over time. The later phase should foster intensive co-creation among employees and selected crowd members (principle 8), and make internal corporate technologies and know-how truly transparent for participants (principle 9).

8. Final thoughts

To conclude, we want to point out that civic challenges have become an important playing field for corporate innovation efforts. Wicked civic challenges not only populate the domain of public planning but also offer new opportunities for firms to establish innovation leadership. We encourage managers to harness the power of the crowd in developing innovation opportunities that shape our future.

References

Almirall, E., Lee, M., & Majchrzak, A. (2014). Open innovation requires integrated competition-community ecosystems: Lessons learned from civic open innovation. *Business Horizons, 57*(3), 391—400.

Bohler-Baedeker, S., Kost, C., & Merforth, M. (2014). *Urban mobility plans: National approaches and local practice*. Berlin: German Federal Ministry for Economic Cooperation and Development.

Bombardier. (2014). *Open innovation 2.0* [Press release]. Retrieved from http://www.bombardier.com/en/media/insight/open-innovation-2-0.html

Camillus, J. (2008). Strategy as a wicked problem. *Harvard Business Review, 86*(5), 98—101.

Cisco. (2014). *Cisco develops smart city blueprint [Customer case study]*. San Jose: Cisco Systems.

Conklin, E. J. (2005). *Dialogue mapping: Building shared understanding of wicked problems*. New York: John Wiley & Sons.

Farley, J. (2007). Wicked problems. *BioScience, 57*(9), 797—798.

Frost & Sullivan. (2014). *Best-in-class smart city integrator: Visionary innovation leadership award*. San Antonio, TX: Frost & Sullivan.

Gwet, K. L. (2014). *Handbook of inter-rater reliability: The definitive guide to measuring the extent of agreement among raters* (4th ed.). Gaithersburg, MD: Advanced Analytics, LLC.

IBM. (2014). *Smarter cities*. Retrieved from http://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/

Innes, J. E., & Booher, D. E. (2010). *Planning with complexity: An introduction to collaborative rationality for public policy*. New York: Taylor and Francis.

Jeppesen, L. B., & Lakhani, K. R. (2010). Marginality and problem-solving effectiveness in broadcast search. *Organization Science, 21*(5), 1016—1033.

Johnson, B., & Gann, D. (2010). *Smart London plan*. London: City of London.

Kietzmann, J.H. (2017). Crowdsourcing — A revised definition and an introduction to new research. *Business Horizons*. In this issue.

Kitchin, R. (2014). The real-time city? Big data and smart urbansims. *GeoJournal, 79*(1), 1—14.

Kozinets, R. (2002). The field behind the screen: Using netnography for marketing research in online communities. *Journal of Marketing Research, 39*(1), 61—72.

Kunz, W., & Rittel, H. W. (1970). *Issues as elements of information systems*. Heidelberg: Studiengruppe for Systemforschung.

Lerner, W. (2011). *The future of urban mobility: Towards networked multimodel cities of 2050*. Boston: Arthur D Little Future Lab.

Maerivoet, S., Daems, F., Maertens, F., Renckens, K., Van Houtte, P., & Buelens, L. (2012). A field trial on smart mobility. *Procedia - Social and Behavioral Sciences, 54*, 926—935.

Majchrzak, A., & Malhotra, A. (2013). Towards an information systems perspective and research agenda on crowdsourcing for innovation. *The Journal of Strategic Information Systems, 22*(4), 257—268.

Malhotra, A., & Majchrzak, A. (2014). Managing crowds in innovation challenges. *California Management Review, 56*(4), 103—123.

Prpić, J., Shukla, P. P., Kietzmann, J. H., & McCarthy, I. P. (2015). How to work a crowd: Developing crowd capital through crowdsourcing. *Business Horizons, 58*(1), 77—85.

Rittel, H. W. (1972). On the planning crisis: Systems analysis of 'first and second generations'. *Bedrifts Okonomen*, 390—396 8(October).

Rittel, H. W., & Webber, M. M. (1973). Dilemmas in a general theory of planning. *Policy Sciences, 4*, 155—169.

Saldana, J. (2012). *The coding manual for qualitative researchers*. Los Angeles: SAGE.

Simon, H. A. (1962). The architecture of complexity. *Proceedings of the American Philosophical Society, 106*(6), 467—482.

Tsoukas, H. (2009). A dialogical approach to the creation of new knowledge in organizations. *Organization Science, 20*(6), 941—957.

U.S. Department of State. (2012, February 14). *Laos 2012 crime and safety report*. Available at https://www.osac.gov/Pages/ContentReportDetails.aspx?cid=11983

Williamson, P. J., & De Meyer, A. (2012). Ecosystem advantage: How to successfully harness the power of partners. *California Management Review, 55*(1), 24—46.

Yin, R. K. (2003). *Case study research: Design and methods*. London: SAGE.

Yuqing, R., Kraut, R., & Kiesler, S. (2007). Applying common identity and bond theory to design of online communities. *Organization Studies, 28*(3), 377—408.

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *The Academy of Management Review, 27*(2), 185—203.